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For the President of the European Patent Office

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Surface coating device

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Surface Coating Device

5 The invention relates to a system for producing and coating an object, comprising a manufacturing machine and a coating device, wherein said coating device comprises a painting station with means for applying a coating to a surface of said object, at least another station for treating said object and a turnable tool with a holder for said object which allows to move said object between said stations. Further the invention relates to a method for producing and coating a moulded object, comprising the steps of producing said object in a manufacturing machine, moving said object to a coating
10 device, which comprises a painting station and at least another station for treating said object, applying a coating to a surface of said object in said painting station and moving said object from said painting station to said another station.

15 Plastic parts or objects are typically manufactured in several steps. The first step comprises moulding of the plastic object by any known plastic injection method, the second step comprises lacquering of the object by any generally known method, the third step comprises any generally known printing method.

20 The plastic objects are conventionally lacquered in an open spray system. Up to several hundred of the objects to be lacquered are placed on a frame which is then sprayed with paint. That system is open to the atmosphere. During the lacquering process, over-spray of paint occur. Such over-spray of paint constitutes an environmental problem and thus additional equipment is necessary to prevent the atmosphere as well as to keep the system itself clean from over-sprayed paint.

25 In WO 03/049929 a single tool for injection moulding as well as painting of an object is disclosed. In an injection moulding station the object is moulded between a turnable mould part and a stationary mould part. The turnable mould part with the object is rotated 90 degrees to another station where paint is applied to the object, with the
30 object still placed on the turnable mould part. In additional stations the paint applied to the object is UV hardened and then the object is ejected from the turnable mould part. Finally the turnable mould part is rotated back to the injection moulding station to start the cycle again.

The advantage of that system is that there is only one machine for the production and painting of the plastic object without the need to transport the object from an injection moulding machine to a painting machine. However, the injection moulding step is essentially faster than the painting and hardening step. Thus by using such a combined injection moulding and painting machine the cycle time is enhanced and the productivity reduced. Further the turnable mould part might be contaminated with paint and thus has to be cleaned from time to time in order to avoid damages of the objects during the injection moulding step.

10

It is an object of the invention to provide a system and a method to apply a coating to an injection moulded object with a high productivity, but reduced manufacturing costs. Further the environmental problems and hazards shall be minimized. Further the quality of the coating shall be increased, in particular with respect to wear resistance and cosmetic and optical aspects.

15

This object is achieved by a system for producing and coating a moulded object, comprising a manufacturing machine and a coating device, wherein said coating device comprises a painting station with means for applying a coating to a surface of said object, at least another station for treating said object and a turnable tool with a holder for said object which allows to move said object between said stations, which is characterized in that said coating device is provided with an enclosure comprising means to create a controlled atmosphere within said enclosure and wherein said manufacturing machine is located outside said enclosure.

25

The inventive method for producing and coating a moulded object comprises the steps of

- producing of said object in a manufacturing machine,
- moving said object to a coating device, which comprises a painting station and at least another station for treating said object,
- applying a coating to a surface of said object in said painting station
- moving said object from said painting station to said another station wherein
- said coating device is provided with an enclosure and

30

- said object is coated and treated in a controlled atmosphere and
- said manufacturing step is performed outside said enclosure.

5 The coating device according to the invention is integrated to the manufacturing machine of the object or free standing from the manufacturing machine. In any case the manufacturing of the object is carried out outside of the enclosure which encapsulates the different stations. Preferably the manufacturing process is not directly coupled to the subsequent coating and treatment steps. That means that neither the manufacturing step nor the coating/treatment step is limited by the other step. In
10 general, the coating and subsequent UV curing of the applied coating needs more time than the manufacturing of the object, for example when the object is produced by injection moulding or metal pouring. In case of a direct coupling the coating / curing steps would constitute a bottle neck of the whole cycle. Therefore, it is advantageous to intermediately store already manufactured objects prior to their coating and further
15 treatment.

It has been found that most of the rejects is due to the handling of the objects in free atmosphere. Thus according to the invention the coating device is provided with an enclosure and at least after the injection moulding step the object is treated in a
20 controlled atmosphere. By using a controlled atmosphere the wear resistance of the object can be essentially increased. The wear resistance is related to hardness and, according to the invention, it is possible to achieve a hardness above pencil hardness of 8,0. The controlled gas atmosphere further influences on lacquer performances as surface hardness, brittleness and cosmetic aspects concerning the object.

25 Preferably said object is coated and treated in an atmosphere with a total dust content of less than 1000 particles per cubic foot, more preferred less than 500 particles per cubic foot.

30 It is preferred to coat and treat the object in an inert gas atmosphere, preferably in a nitrogen and/or carbon dioxide atmosphere.

Preferably the object is put into clean room conditions directly after its manufacturing and held under clean room conditions during the transfer to the coating device. For
35 example the objects may be charged into a cassette which itself is then placed into a

box which has an overpressure of clean air or inert gas. The number of objects that must be discarded due to damages is thereby considerably reduced.

5 In a preferred embodiment the objects are packed and transferred as well as treated in the several stations of the coating device without any manual handling. Unloading the objects from the manufacturing machine, transfer to the coating device, treating within the coating device as well as removing the objects from the coating device and final packing of the objects are carried out automatically.

10 In particular when UV radiation is used to harden the coating applied to the object it is advantageous to provide an atmosphere having a low oxygen content, preferably less than 500 ppm, more preferred less than 180 ppm. The importance of low oxygen content in environment is to make use of the photo initiator concentration in the lacquer.

15

According to the invention a controlled atmosphere is produced within the enclosure. The controlled atmosphere may be an atmosphere of pre-cleaned air or, preferably, an inert gas atmosphere. In some cases it is further advantageous to have different atmospheres in different stations within the enclosure. For example it is often sufficient
20 to have an atmosphere of clean air within the loading and unloading station of the coating device, whereas it is preferred to have an inert gas atmosphere in the painting station and the UV curing station.

25 The station where the coating is applied to the object is preferably equipped with a supply equipment of lacquer, paint or any other substance which is the object to be coated with. Within this description the expressions "lacquer", "paint" and "coating" are used synonymously.

30 In a preferred embodiment the lacquer is driven from the lacquer supply to a spray head with gas, preferable nitrogen or carbon dioxide, and then sprayed by the spray head to the object. Especially by using a low pressure gas, below 3 bars or even below 1 bar in order to propel and spray the lacquer, the object can be coated in a very precise manner. The gas atomizes the lacquer into droplets. Thus small volumes of lacquer can be applied to the object, preferably 0,005 to 0,010 gram per square cm.

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In a preferred embodiment the spray head or the spray gun is movable. The movement of the spray head is designed according to the geometry of the object. That movement of the spray head allows to provide large surfaces with an even coating of equal thickness. The moveability of the spray gun or the spray head allows to follow two-
5 dimensional and three-dimensional object surfaces and shapes. In particular the lacquering of three-dimensional surfaces is essentially improved. Further by moving the spray head according to the dimensions of the object any over-spraying is minimized, that is the volume of lacquer which is not applied to the object is reduced.

10 To prevent contamination of the painting station itself it is advantageous to provide the object with a metallic adapter with an interface design according to the geometry of the object or of parts of the object. The object is masked by that adapter and only those parts of the object which are to be coated are sprayed with the lacquer. The movement of the spray head is preferably carried out by mechanical and/or pneumatic
15 arrangements.

The controlled atmosphere within the painting station and the controlled flow of lacquer assures that the lacquer is applied precisely where it is desired. Any over spray of lacquer is reduced and with regards to solvents and lacquer full environmental control
20 is achieved.

The object to be coated is placed into a holder on a turnable tool. The turnable tool is controlled and programmed to different stations of the coating device. It is preferred to provide said turnable tool with interchangeable holders. The coating device may thus
25 be used for treating objects of different design and geometry. The holder is preferably designed to hold between 4 and 8 objects which then can be coated and treated at the same time.

In addition to the painting station the coating device preferably comprises a UV
30 treatment station with a UV radiation source. The UV treatment station where UV-curing occurs is equipped with an UV-source and cold mirrors to reflect the UV-rays. The UV-light equipment is encapsulated. The surface of the object which is exposed to UV-rays is protected with a silicon glass. The UV-rays are emitted to the object through the silicon glass into an environment where the content of oxygen is extremely low. The
35 importance of low oxygen content in the environment is to make use of the photo

initiator concentration in the lacquer. The controlled gas atmosphere influences on lacquer performances as surface hardness, brittleness and cosmetic aspects concerning the object.

- 5 According to another embodiment the coating device further comprises a printing station where at least one surface of the object can be printed. The printing station is in particular designed to and equipped with tampo-printing equipment.

10 Advantageously the object holders have got a specific design that allows printing of two surfaces of the object without turning the object. The holder is designed in form of a frame so that printing can occur from upside down and from downside up, that is both sides of the object can be printed at the same time or subsequently. This specific design which allows printing on two opposite surfaces of the object may also be used in the painting station in order to coat two opposite surfaces of the object.

15

The invention is in particular useful in the production and coating of plastic or metal objects, such as lenses, display glasses, lamps, protection glasses, watches, home electronics, consumer electronic goods and medical equipment.

20

The invention as well as further details and preferred embodiments of the invention are disclosed in the following description and illustrated in the accompanying drawings, in which

- figure 1 schematically shows a coating device according to the invention,
25 figure 2 a cassette to carry the objects to be coated and
figure 3 details of the painting station and the UV treatment station.

Figure 1 shows a device according to the invention which is used to lacquer a display window for a mobile telephone or another consumer electronic product. In such parts it
30 is known to provide the surface of some of the plastics parts with a layer of lacquer. The lacquer may be applied for aesthetical and/or protective reasons. For example, a raw plastics surface may be given an improved appearance by treating it with lacquer, and a plastics component may be given improved resistance to wear and chemicals by providing a protective layer of lacquer on the surface thereof. Other example on above-
35 mentioned treatment is front lights for automobiles where glasses are replaced by

polycarbonate. These glasses shall as well have an optical performance. Other examples are display glasses for mobile telephones. The display glasses are preferable made by PMMA.

- 5 In the first step the object is manufactured in a conventional plastic injection moulding machine or in a metal pouring machine. The whole equipment is placed in a clean-room atmosphere. The object is charged from the injection machine into a cassette (1) (see figure 2). The cassette (1) will be charged with several objects. The cassette (1) is designed with flexible ribs (2) where objects of different dimensions can be charged.
- 10 The ribs (2) grant no movement of the objects during the handling and transport.

The cassette (1) is packed in a box, all still in the clean room atmosphere to avoid dust and damages. The box in which the cassette (1) is packed has an overpressure of inert gas or filtered air before packaging to ensure that it is free from dust and particles.

- 15 The box with the cassettes (1) is then transported to the inventive coating device.

- The coating device comprises an enveloped and air/gastight room (3). Into that room (3) a turnable disc (4) or conveyor or other fitment equipment for object holders (5) is mounted. Into the holders (5) the objects (6) are placed. By means of the turnable disc (4) the objects (6) are turned into the different stations (7, 8, 9, 10, 11, 12), which are all mounted into the enveloped and air/gastight room (3).
- 20

- The air/gastight room (3) is a clean-room area where filtered air (13) is blown into the room (3) through a Hepa filter (13) which is classified 50 000.
- 25

- In the first step of operation – in loading station (7) – a cassette (1) with the objects (6) is moved into the clean-room area (3) and automatically positioned at the turnable disc (4). Four objects (6) are discharged at the same time from the cassette (1) and placed into the object holders (5).
- 30

In the next station (8) the objects (6) are heated by infrared radiation to a certain temperature requested for the subsequent lacquering process. Before entering the lacquering process an antistatic treatment occurs, too.

In the painting station (8) a layer of lacquer is applied on selected areas of the object (6). The lacquer is atomised (15) by an inert gas (16), preferable carbon dioxide or nitrogen. The lacquer is sprayed or applied by a precision application method and low pressure to avoid turbulence in stream.

5

The lacquer is preferable a UV-curable lacquer that is cured by exposing the lacquer to UV-light emitted from a UV-lamp (17) in UV treatment station (9). The UV lamp (17) is located in an encapsulated room (18) which is provided with an atmosphere with low oxygen content. This is established by feeding (19) an inert gas, such as nitrogen or carbon dioxide, into the encapsulated room (18) in order to achieve a gas-stabilised environment. The atmosphere influences the performances of the lacquer, for example the wear resistance in form of hardness and brittleness.

10

The inventive coating device is further equipped with process stations (10, 11) where deflashing and printing/lacquering occur. The printing is carried out in a conventional tampo print unit based on conventional lacquer method cured by infrared radiation or UV-curable lacquer that is cured by exposing the lacquer to UV-light.

15

Printing station (11) is designed that printing/lacquering will occur on both sides of the object (6) in the same operation. The object holder (5) is a kind of frame which holds the object (6) at its edges. Thus the top and the bottom side of the object (6) can be printed simultaneously.

20

Finally turnable disc (4) is rotated to position the objects (6) in reloading station (12) where the objects (6) are automatically discharged from the holders (5).

25

The example described shows a surface coating (8), hardening (9), printing (11) disassembling and packaging procedure. For the man skilled in the art it is obvious that additional process stations can be added to the coating device. For example an assembling station may be included for assembling other material to the coated and treated objects (6). For example windows for mobile phones are coated, UV hardened and printed as described above and then assembled with covers for mobile phones which are also introduced into the assembling station of the device.

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Claims

1. System for producing and coating an object, comprising a manufacturing machine and a coating device, wherein said coating device comprises a painting station with means for applying a coating to a surface of said object, at least another station for treating said object and a turnable tool with a holder for said object which allows to move said object between said stations, characterized in that said coating device is provided with an enclosure (3) comprising means to create a controlled atmosphere within said enclosure (3) and wherein said manufacturing machine is located outside said enclosure (3).
5
- 10 2. System according to claim 1, characterized in that said manufacturing machine is an injection moulding tool or a metal pouring machine.
- 15 3. System according to claim 1 or 2, characterized in that an adapter is provided in order to mask said object when said coating is applied to said object (6).
4. System according to any of claims 1 to 3, characterized in that said means for applying a coating to a surface of said object (6) comprise a movable spray head.
- 20 5. System according to any of claims 1 to 4, characterized in that said turnable tool (4) is provided with interchangeable holders (5).
- 25 6. System according to any of claims 1 to 5, characterized in that said coating device further comprises a UV treatment station (9) with a UV radiation source (17), a printing station (11) and / or an assembling station.
- 30 7. System according to any of claims 1 to 6, characterized in that said means for applying a coating to a surface of said object comprise a spray gun, preferably a moveable spray gun, a tamper-printer or a transducer.
8. Method for producing and coating a moulded object, comprising the steps of
– producing said object in a manufacturing machine
– moving said object to a coating device, which comprises a painting station and at least another station for treating said object,

- applying a coating to a surface of said object in said painting station
- moving said object from said painting station to said another station

characterized in that

said coating device is provided with an enclosure (3) and that said object is coated
5 and treated in a controlled atmosphere and that said manufacturing step is
performed outside said enclosure (3).

9. Method according to claim 8 characterized in that said object is produced by
injection moulding or by metal pouring.

10

10. Method according to claim 8 or 9 further comprising the steps of hardening said
applied coating by UV radiation (17) and / or of printing said object.

11. Method according to any of claims 8 to 10 characterized in that said object (6) is
15 coated and / or printed on two opposite surfaces without turning said object (6).

12. Method according to any of claims 8 to 11 characterized in that said object (6) is
coated and treated in an inert gas atmosphere, preferably in a nitrogen and/or
carbon dioxide atmosphere.

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13. Method according to any of claims 8 to 12 characterized in that said object (6) is
coated and treated in an atmosphere with a total dust content of less than 1000
particles per cubic foot, preferable less than 500 particles per cubic foot.

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14. Method according to any of claims 8 to 13 characterized in that at least one of said
steps of coating and treating said object is performed in an atmosphere having a
low oxygen content, preferably less than 500 ppm, more preferred less than 180
ppm.

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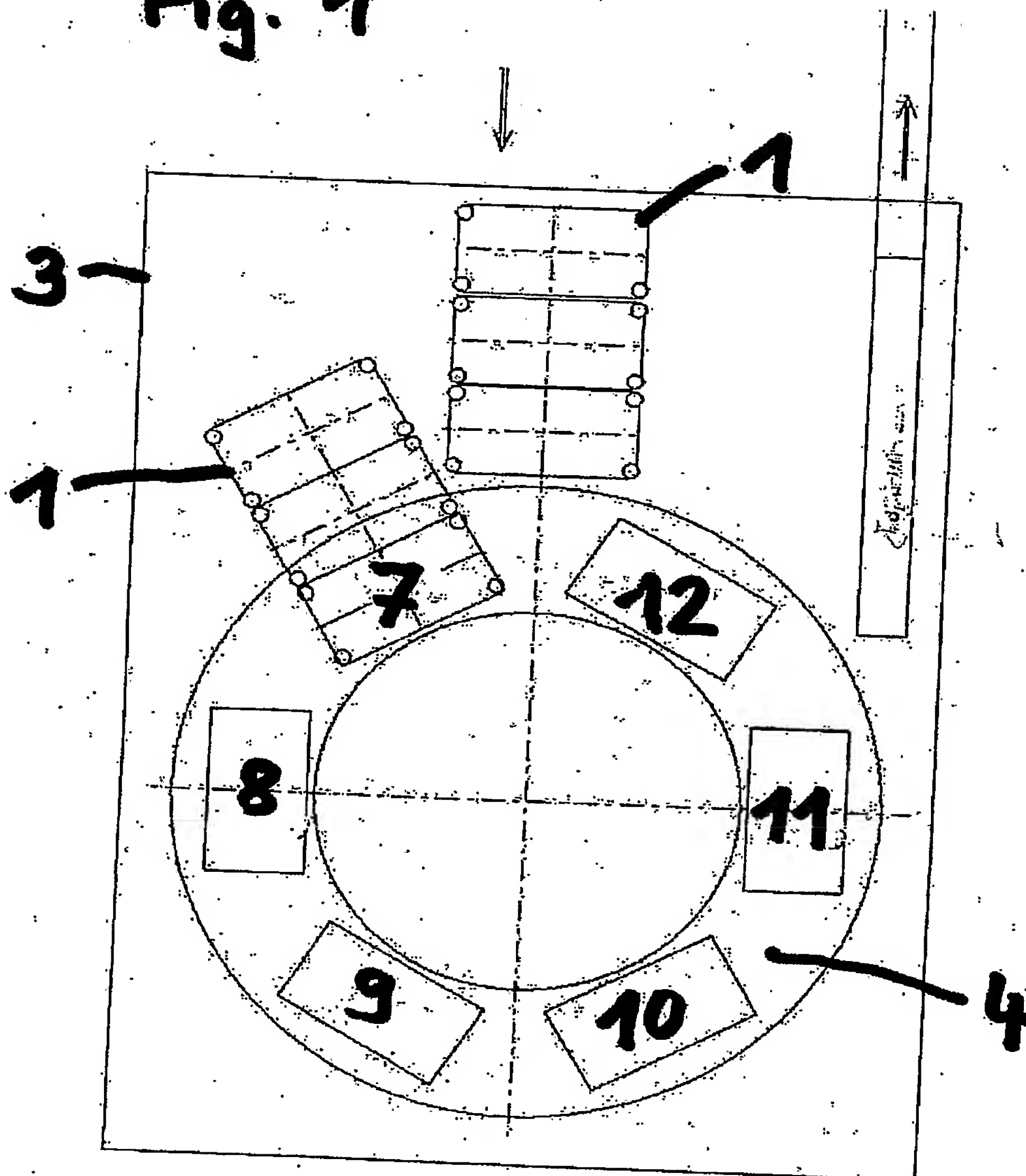
15. Method according to any of claims 8 to 14 characterized in that said object (6) is
provided with a mask prior to said coating step.

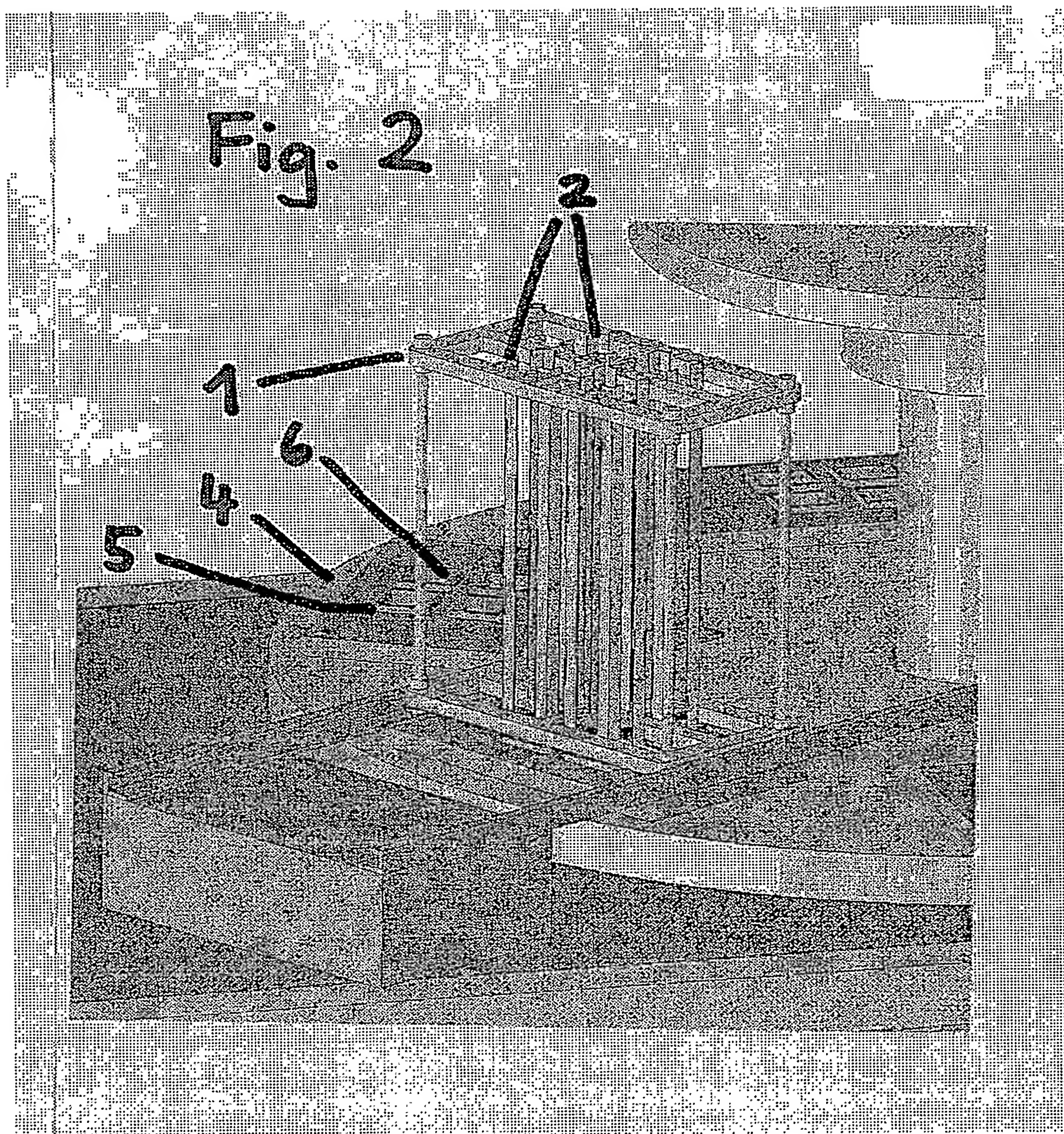
16. Method according to any of claims 8 to 15 characterized in that in said coating step
lacquer or paint is atomized with an inert gas (16) and sprayed to said object (6).

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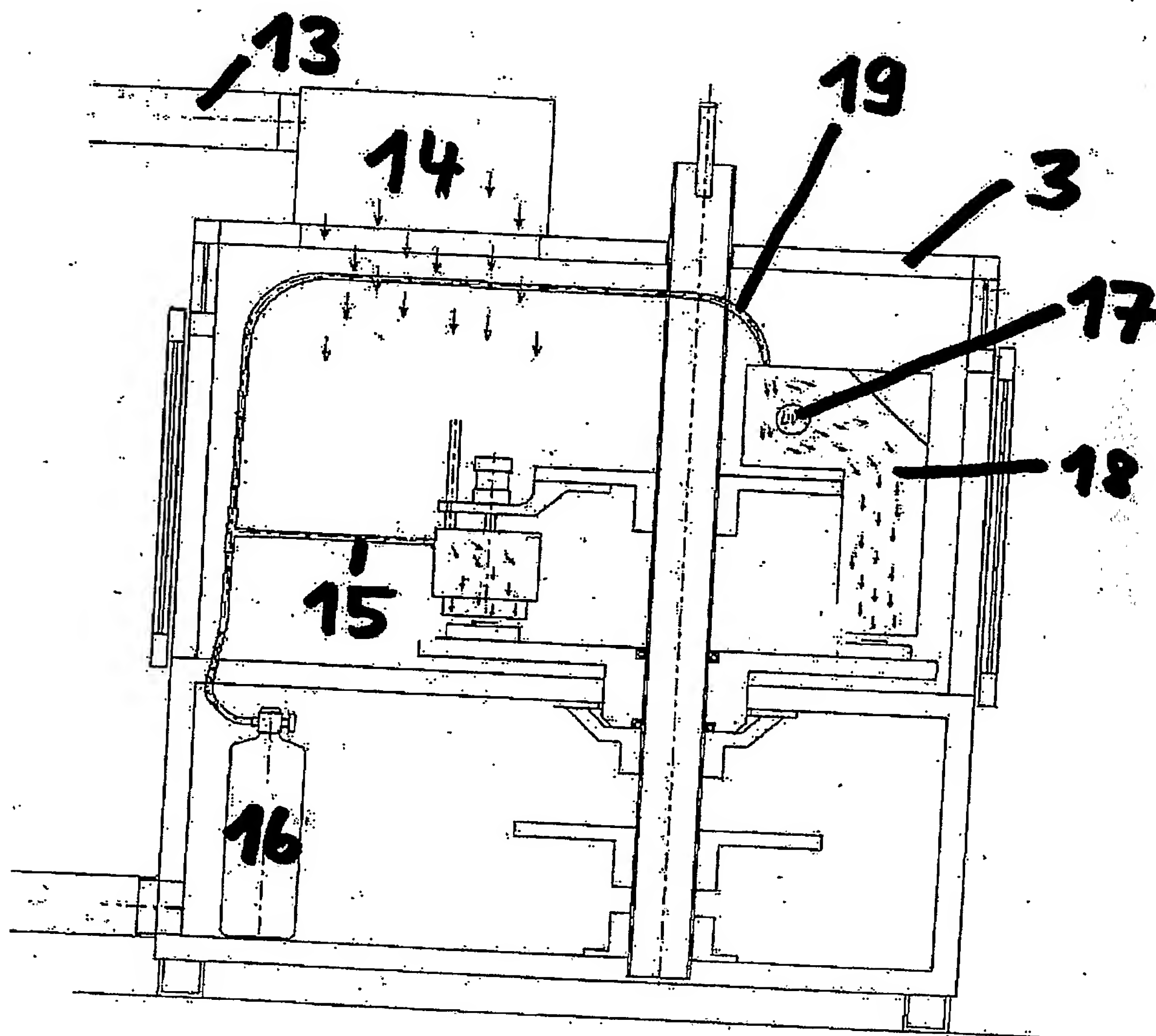
Fig. 1





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Fig. 3



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Abstract

Surface Coating Device

The invention relates to a system and a method for producing and coating an object (6), comprising a manufacturing machine and a coating device. The coating device
5 comprises a painting station (8) with means for applying a coating to a surface of said object (6), at least another station (9, 10, 11, 12) for treating said object (6) and a turnable tool (4) with a holder (5) for said object (6) which allows to move said object (6) between said stations (7, 8, 9, 10, 11, 12). The coating device is provided with an
10 enclosure (3) comprising means to create a controlled atmosphere within said enclosure (3). The manufacturing machine is located outside said enclosure (3).
(figure 1)

